# INSTRUCTION MANUAL

MODEL 4112
POSITIONER CONTROL UNIT

DEPT. 250 F

SCIENTIFIC-ATLANTA, INC.

*When ordering parts from Scientific-Atlanta, Inc., be sure to include the equipment model number, equipment serial number, and a description of the part.*

MODEL NO. 4112

SERIAL NO. 489

# INSTRUCTION MANUAL

Model 4112L
Hand-Held
Local Control

MODEL 4112
POSITIONER CONTROL UNIT

DEPT. 280 FILE NO. 4
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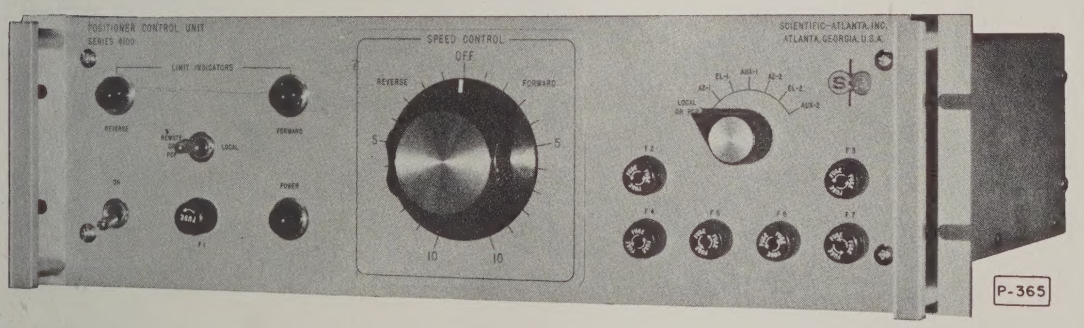


Model 4112 Positioner Control Unit

Fourth Edition
October 1964



Price for Additional Copies $1

# INSTRUCTION MANUAL
# CHANGE NOTICE

MODEL 4112. FOURTH EDITION, OCTOBER 1964

To make this manual apply to your instrument, make the manual changes shown below.

| Instrument Serial No. | Change |
|---|---|
| 4112L only; 44 and up | 1 |
| 357 and up | 2 |
| | |
| | |

| Instrument Serial No. | Change |
|---|---|
| | |
| | |
| | |
| | |

Change 1: On Fig. 2.1, Fig. 3.1, Fig. 3.2, and the 4112/4112L schematic diagram, add a male receptacle (J1) to the local control unit and a mating cable connector to the local-control-unit cable (the pins are wired as in A3P1). Add a female receptacle (J4) to the junction box and a mating cable connector to the positioner cable (the pins are wired as in A2P1). Designate the local-control-unit cable as B31888 and the junction-box-to-positioner cable as B31889. On page 5-4, delete cable connector P1. Add: "J4; Connector, receptacle, female, 22 contacts; ABE; MS3102A-28-11S." On page 5-5, delete cable connector P1. Add: "J1; Connector, receptacle, male, 37 pins; ABE; MS3102A-28-21P."

Change 2: Add a 0.1-μf capacitor (C1) from pin 8 to pins 9 and 10 of relay K3A. Add a 0.1-μf capacitor (C2) from pin 10 to pins 7 and 8 of relay K4A. On page 5-2, add: "C1, C2; capacitor, fixed, Mylar, 0.1 μf, 200v; Cornell Dubilier; WMF2P1E."

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# CHAPTER 1
# GENERAL DESCRIPTION

## 1.1 Introduction

The Scientific-Atlanta Model 4112 Positioner Control Unit offers complete centralized control of two three-axis antenna positioners. Provisions are made for positioner and axis selection, control of drive-motor speed and direction, limit indication, and remote or local control. Automatic dynamic braking of the drive motors prevents excessive overtravel when the antenna reaches a limit. Solid-state components and enclosed relays are used to provide maximum reliability and to minimize down time and maintenance.

The Model 4112 can be used directly in conjunction with a Scientific-Atlanta Model 2004 Positioner Programmer to provide a completely automatic antenna positioning and scanning system.

## 1.2 Specifications

| | |
|---|---|
| Load Characteristics | |
| Motor Type | DC shunt |
| Motor Rating | 3/4 hp (max.) |
| Armature Supply | 0-120 volts dc, 6.5 amperes maximum, continuous (8.5 amperes for 50% duty cycle, "on" period less than 10 minutes) |
| Field Supply | 105 volts dc, 5 amperes maximum |
| Input Voltage | 105-125v ac, 50/60 cps, 1$\phi$ |
| Input Power | |
| Full Load | 1300 watts |
| Standby | 350 watts (max.) |
| Dimensions | Standard 19-inch panel, 5-1/4 inches high |
| Weight | 19 pounds net |

# CHAPTER 2
# INSTALLATION AND OPERATION

## 2.1 Installation

The positioner control unit may be installed in any position. All connections are made through Amphenol Type MS connectors located on the rear of the chassis. Refer to the schematic diagram at the rear of this manual for pin connections.

Fig. 2.1 shows cable connections to be made with various configurations of accessory equipment for the Model 4112 Positioner Control Unit. Note that a dummy connector must be inserted in J2 on the control unit to jumper pins R and S when neither a local control unit nor a positioner programmer is used. Only one positioner can be operated locally with the standard Model 4112 Positioner Control Unit and a Model 4112L Local Control Unit; refer to Fig. 2.1 for cable connections. Accessory equipment for local operation of two positioners is available on special order.

### 2.1.1 Limit Switch Option

It is possible to drive an antenna positioner with the Model 4112 Positioner Control Unit when limit switches are not used on a particular positioner axis. For operation of an axis without limit switches, connect jumpers on terminal board TB1 in the control unit between the terminals listed below.

| | Axis | Connect Terminal |
|---|---|---|
| Positioner No. 1 | AZ-1 | 7 or 8 to 1 and 9 |
| | EL-1 | 7 or 8 to 2 and 10 |
| | AUX -1 | 7 or 8 to 3 and 11 |
| Positioner No. 2 | AZ-2 | 7 or 8 to 4 and 12 |
| | EL-2 | 7 or 8 to 5 and 13 |
| | AUX-2 | 7 or 8 to 6 and 14 |

### 2.1.2 Armature Fuses

To provide drive-motor protection, proper fuse sizes should always be used. Install fuses according to the list below.

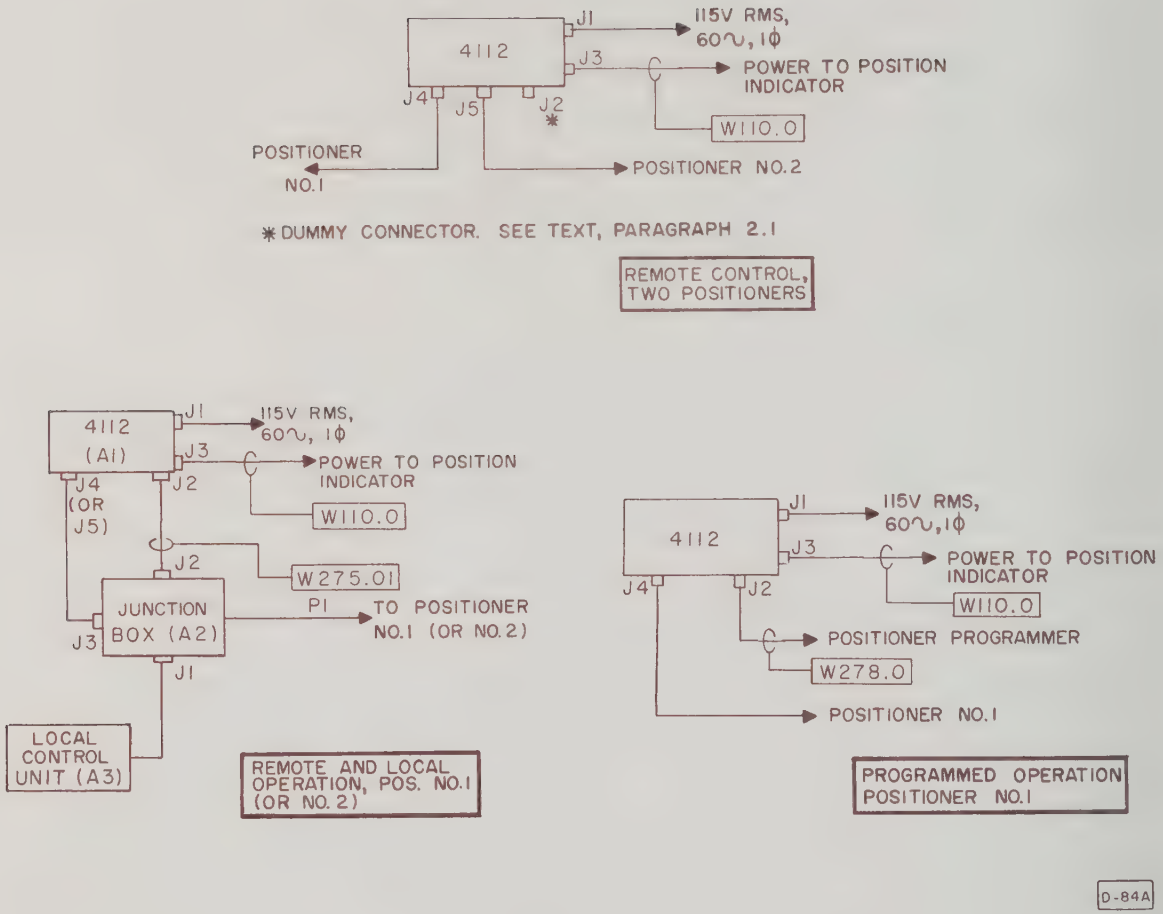



Fig. 2.1. Cabling Diagrams

| Motor Size | Control Unit or Local Control Unit Fuse |
|---|---|
| 1/12 horsepower | 1.5a, 3AG, slow blow |
| 1/8 horsepower | 2a, 3AG, slow blow |
| 1/3 horsepower | 4a, 3AG, slow blow |
| 3/4 horsepower | 8a, 3AB, medium lag |

The armature fuses are labeled F2 through F7 and correspond to the positions marked on the selector switch. For example: F2--AZ-1, F3--EL-1, etc. The local control unit fuse is located inside the unit.

2.1.3 Line Fuse

Fuse F1 should be chosen for the largest motor to be driven. Install a fuse in fuse-holder F1 per the chart below.

| Motor Size | Fuse |
|---|---|
| 1/12 horsepower | 3a, 3AG, slow blow |
| 1/8 horsepower | 3a, 3AG, slow blow |
| 1/3 horsepower | 5a, 3AG, slow blow |
| 3/4 horsepower | 10a, 3AG, medium lag |

## 2.2 Supplementary Installation Information

When it is desired to control a dc motor other than one supplied with Scientific-Atlanta equipment, the following information may prove useful in determining the proper connections to be made to the positioner control unit.

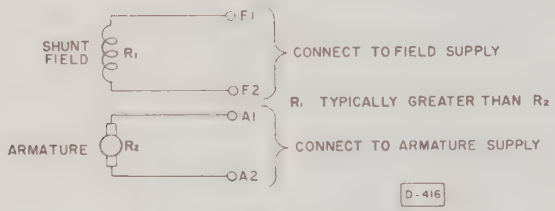
The most common types of dc motors which can be operated from the Model 4112 are shunt, compound, and series. Diagrams of typical configurations for each type are shown below.

The armature terminations, designated as A1 and A2, should be connected to the armature supply of the control unit. The shunt-field terminals, designated F1 and F2, should be connected to the field supply of the control unit. Reversal of direction is accomplished by changing the polarity of the voltage applied to the armature winding while maintaining the field-voltage polarity constant.

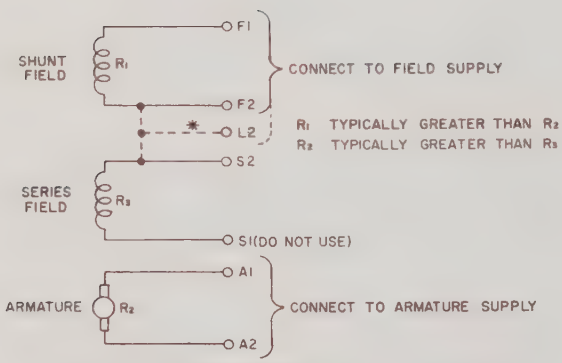
The series-field winding in a compound motor is not used and should be isolated but not short-circuited. In some motors this winding is brought out to two terminals (S1 and S2) or may have one of its terminals common with the shunt field (L2 or S2-F2).

For each type of motor, the armature- and field-circuit currents should be measured. Do not allow the currents to exceed those for which the motor and the positioner control unit are rated.

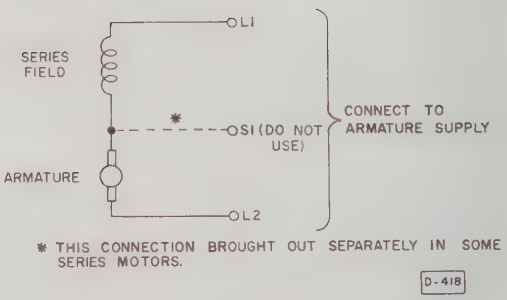
The information contained in this paragraph is of a general nature. Therefore, it is recommended that each individual motor be thoroughly investigated, and all motor terminals positively identified, before actually connecting the motor to the positioner control unit. Relative resistance values of various motor windings are given on the diagrams below.




TYPICAL SHUNT MOTOR




TYPICAL COMPOUND MOTOR




TYPICAL SERIES OR UNIVERSAL MOTOR (NON-REVERSING)

## 2.3 Operation

### 2.3.1 Functions of Controls

The following is a brief description of each control and its function (see frontispiece photo).

REMOTE OR PCP-LOCAL switch--Determines whether the Model 4112 is used to operate the positioner directly (REMOTE), from a local control unit at the positioner (LOCAL), or from a Model 2004 Positioner Programmer (PCP). NOTE: When a local control unit is used, the REMOTE-LOCAL switch on the local control unit and on the positioner control unit must be in the same position.

SPEED CONTROL--Determines the speed and direction in which the antenna is driven. When it is in the OFF position, the drive motor is stopped. When operation is from the local control unit or the positioner programmer, the SPEED CONTROL may be placed in either the FORWARD or REVERSE range. It is recommended that this control be placed at a setting less than "7" during local or programmed operation.

Selector Switch--Determines which axis of either of two antenna positioners is to be controlled by the positioner control unit. For operation from the local control unit, the selector switch must be in the LOCAL OR PCP position.

### 2.3.2 Preliminary

Before applying power to the Model 4112, place the front-panel controls in the following positions.

| | |
|---|---|
| POWER | OFF |
| REMOTE OR PCP-LOCAL | REMOTE OR PCP |
| SPEED CONTROL | OFF |

The selector switch should be placed in any position except LOCAL OR PCP. Make sure that the positioner control cables are attached to the proper connector: positioner No. 1 to J-4 and positioner No. 2 to J-5.

### 2.3.3 Checkout, Remote Control

Connect the power cord to an ac source capable of supplying 15 amperes. Be sure to connect the ground conductor of the power cord to the system ground of the ac source.

If travel past a limit will cause damage to the positioner or antenna, manually check the limit switches before the limits are reached during the following procedures.

Energize the unit. The POWER lamp should glow to indicate that power is applied to the unit.

Move the SPEED CONTROL to FORWARD-5. The drive motor chosen by the selector switch should drive the antenna clockwise; for example, if the selected axis is "elevation", the elevation angle should increase.

Allow the drive motor to run until a limit is reached. At this point, the FORWARD LIMIT INDICATOR should be illuminated.

Move the SPEED CONTROL to REVERSE-5. The FORWARD LIMIT INDICATOR should extinguish, and the drive motor should run until the reverse (counterclockwise) limit is reached. At this point, the REVERSE LIMIT INDICATOR should light.

Move the selector switch to another axis, or to the other positioner (if used), and repeat the steps above.

If a selected axis is not equipped with limit switches and if jumpers have been connected per paragraph 2.1.1, the selected drive motor should run continuously in the direction and at the speed determined by the setting of the SPEED CONTROL.

If difficulty is encountered in the checkout procedure, refer to Chapter 4 of this manual.

### 2.3.4 Checkout, Local Control

When a Model 4112L Local Control Unit is to be used with the positioner control unit, set the REMOTE OR PCP-LOCAL switch on the Model 4112 to LOCAL and the selector switch to LOCAL OR PCP. Place the SPEED CONTROL about midway in either the FORWARD or REVERSE range.

At the local control unit, place the REMOTE-LOCAL switch in the LOCAL position, the direction switch in FORWARD, and hold the PUSH TO RUN button. The positioner drive motor chosen by the selector switch should drive the antenna clockwise at a speed determined by the setting of the SPEED CONTROL on the Model 4112. If the selected axis is "elevation," the elevation angle should increase. Release the push-button. The drive motor should brake to a stop. Hold the pushbutton down until the antenna reaches a limit. At this point the drive motor should brake to a stop. Repeat this procedure in the REVERSE direction and in all other positions of the selector switch.

During local operation, the LIMIT INDICATOR lamps on the Model 4112 are inoperative.

If a Scientific-Atlanta Positioner Programmer is used with the Model 4112, set the REMOTE OR PCP-LOCAL switch to REMOTE OR PCP, and the SPEED CONTROL to FORWARD or REVERSE. Refer to the programmer instruction manual for further details.

If difficulty is encountered in the checkout procedure, refer to Chapter 4 of this manual.

# CHAPTER 3
# DETAILED DESCRIPTION

In the description of the control unit that follows, simplified diagrams are used to explain the unit's operation. These diagrams show the local control unit and junction box connected to the positioner control unit. If your unit is not equipped with a local control unit, the local control circuits shown can be disregarded.

For clarity, certain components have been omitted from the diagrams in this chapter. Switch positions in these diagrams are shown for the "auxiliary" axis of positioner No. 1, which is connected to J4 of the positioner control unit. Operation of other positioner axes is similar. Schematic diagrams of the positioner control unit, local control unit, and junction box are included at the rear of this manual.

To aid in the identification and location of components in the control unit, the major subunits have each been assigned a prefix number as follows:

| Prefix | Subunit |
|---|---|
| A1 | 4112 Positioner Control Unit |
| A2 | Junction Box |
| A3 | 4112L Local Control Unit |

For example, relay A1K1 is located in the positioner control unit. Switch A3S1 is located in the local control unit.

## 3.1 Armature and Direction Circuits, Remote Mode

Line voltage is applied to variable autotransformer A1T1 through connector A1J1, switch A1S1, and fuse A1F1. The output of the autotransformer (see Fig. 3.1) is connected directly to a full-wave silicon-diode bridge consisting of A1CR5 through A1CR8. Surge protector A1CR11 prevents damage to the diodes in the armature supply from switching transients; A1CR10 suppresses arcing on the contacts of relays A1K2 and A1K3.

Relay A1K2 determines the polarity of the voltage to be applied to the drive-motor armature and hence the direction of rotation of the drive motor. The armature is connected to the armature supply through selector switch A1S5C, A1K5B, and A1K3A.

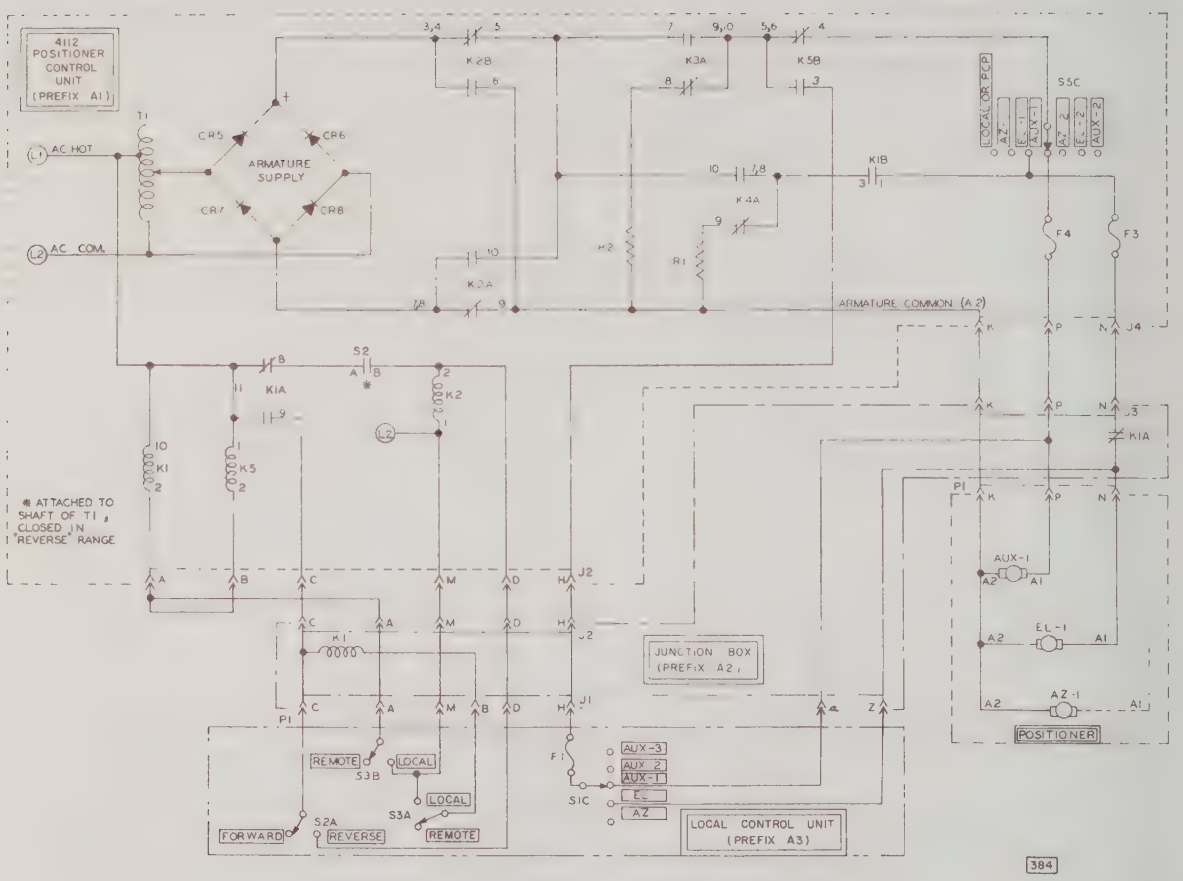



Fig. 3.1. Armature and Direction Circuits, Simplified Diagram

When a limit switch in the positioner opens (see paragraph 3.4), relay A1K3 is de-energized and contact A1K3A closes connecting resistor A1R2 across the armature. This resistor provides rapid dynamic braking of the drive-motor armature. The value of A1R2 is chosen to provide maximum deceleration of the armature while at the same time limiting the braking torque to a safe value in order to prevent possible mechanical damage to the test antenna mounted on the positioner.

## 3.2 Armature and Direction Circuits, Local Mode

To transfer armature control to the local control unit, relays A1K1 and A1K5 must be energized. When REMOTE-LOCAL switch A3S3B in the local control unit is closed (Fig. 3.1), relays A1K1 and A1K5 are energized. (Note that the SPEED CONTROL on the control unit can be in either the FORWARD or REVERSE range for local operation, since A3S2A and A3S4 in the local control unit now control A1K2.)

Armature selection is transferred to the local control unit through A1K5B. Selector switch A1S1C is then used to connect the desired drive-motor armature to the armature supply.

Relay A2K1, located in the junction box, is energized when A3S3A in the local control unit is placed in the LOCAL position; hence, contact A2K1A disconnects resistor A1R1 from the armature supply during local operation.

## 3.3 Armature and Direction Circuits, PCP Mode

When a Scientific-Atlanta Positioner Programmer is connected to A1J2, relays A1K1, -K2, -K3, and -K4 are operated from the programmer. Relay A1K4 (shown on the overall schematic diagram at the rear of this manual) connects the armature supply to the programmed axis drive motor armature of positioner No. 1 during the programmed mode of operation. Relay A1K4 and armature relay A1K3 are alternately energized from the $\phi$-$\theta$ switching relay in the programmer unit. Reversing relay A1K2 is energized through pin D of A1J2 from contacts of the forward-reverse switching relay in the programmer.

It should be noted that any two axes of one positioner may be chosen to be programmed and should be so specified at the time of ordering. The overall schematic diagrams and the two simplified circuit diagrams in this manual show positioner No. 1 as being connected for programming, with the aximuth axis (AZ-1) connected as the $\phi$ axis and the elevation axis (EL-1) as the $\theta$ axis.

For further details regarding the operation of the positioner control unit with Scientific-Atlanta Positioner Programmers, refer to the programmer instruction manual.

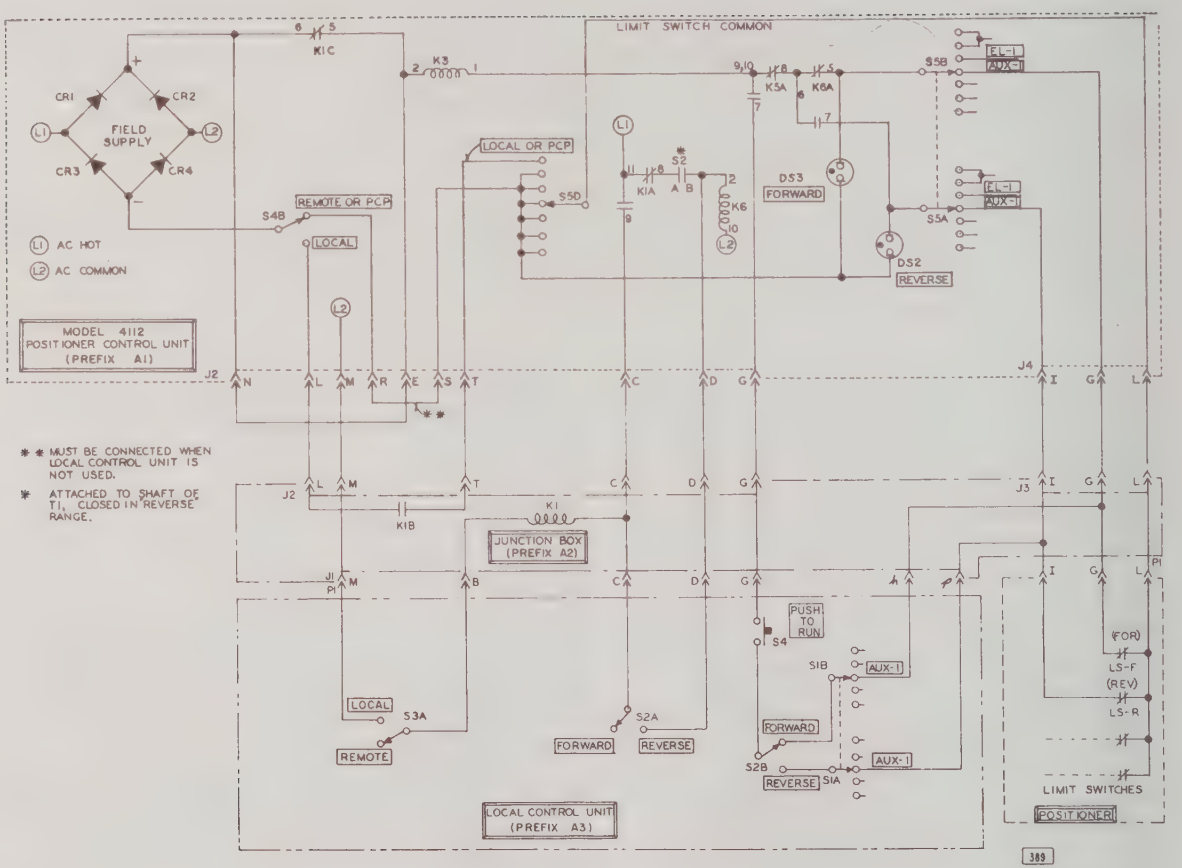
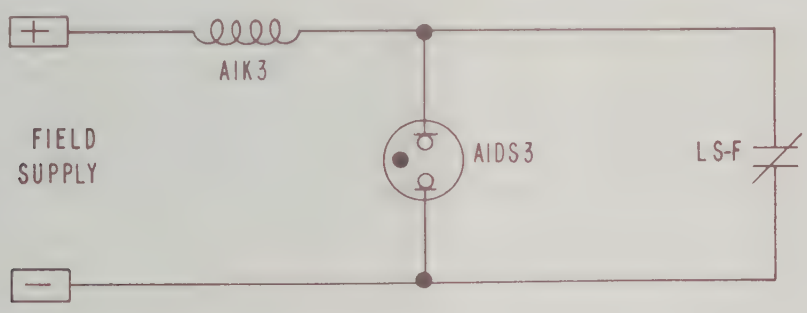



Fig. 3.2. Limit Switch Circuits, Simplified Diagram

## 3.4 Limit Switch Circuits, Remote Mode

Normally closed switches in the antenna positioner (see Fig. 3.2) hold in the dynamic braking relay (A1K3) until a limit is reached. At such time, relay A1K3 is de-energized, the drive motor is braked to a stop, and the appropriate LIMIT INDICATOR is illuminated.

Assume that remote operation is in progress and the antenna is being rotated clockwise (forward) about the AUX-1 axis. (Typically, this axis might be used for polarization positioning; other axes are similar.) Armature relay A1K3 is held in by the AUX-1 forward limit switch, LS-F. The drive motor continues to run until the preset limit is reached and LS-F opens, releasing A1K3. Indicator A1DS3 is then illuminated from the positive terminal of the field supply through the coil resistance of A1K3. Because A1DS3 is a neon-glow lamp, its illuminating current is not sufficient to hold in A1K3. The circuit for lamp A1DS3 is shown here.




The normally closed limit switch is effectively connected in parallel with A1DS3, thereby preventing its illumination until LS-F is opened.

The "A" contacts of relay A1K6, the coil of which is connected in parallel with that of reversing relay A1K2, select the limit switch corresponding to the direction of rotation of the antenna about the selected axis.

## 3.5 Limit Switch Circuits, Local Mode

Operation of the limit-switch circuits in the local mode is similar to that in the remote mode. The limit-switch common line is derived from the negative terminal of the field supply through A1S4B (LOCAL), relay contact A2K1B in the junction box, and A1S5D (LOCAL OR PCP). The "A" contacts of relay A1K5, which is energized in local operation, transfer the energizing circuit for relay A1K3 to the FORWARD-REVERSE switch in the local control unit. When A3S2B is in the FORWARD position and the PUSH TO RUN button is depressed, relay A1K3 is energized as long as limit

switch LS-F is closed. Note that relay A1K3 de-energizes when A3S4 is released, thereby braking the positioner to a stop. Operation in REVERSE is similar, except that limit switch LS-R holds in relay A1K3.

Relay A2K1 in the junction box is energized when A3S3A is in LOCAL. It is de-energized when A3S3A is in REMOTE, A2K1B is opened, and the limit-common line is broken thereby disabling the system.

Sections A, B, and C of selector switch A3S1 in the local control unit are ganged together so that the corresponding forward and reverse limit switches are selected with the drive motor for that axis.

The LIMIT INDICATORS are not illuminated when a limit is reached in local operation.

## 3.6 Field-Supply Circuit

Diodes A1CR1 through A1CR4 constitute the field supply, which is powered directly from the ac line. In addition to supplying a constant full-wave-rectified field voltage to the drive motors in the positioner(s), this supply provides the operating voltage for several relays in the system. A surge protector, A1CR9, in parallel with the field-supply output prevents transients from damaging the diodes in the supply.

# CHAPTER 4
# MAINTENANCE

Should a malfunction occur in the operation of the equipment, a visual check of all cables, connectors, relays, and switches should be made.

If a relay contact is suspected as a possible source of trouble, a resistance check should be made through the closed contacts. Unplug the relay from its socket, connect an ohmmeter across the suspected contacts, and energize the coil from an external source. Contact resistance should be of the order of 0.5 to 1 ohm and should remain relatively constant throughout each of ten normal operations. All relays in the system (with the exception of A2K1 in the local junction box) are sealed and should not be opened.

Check the limit switches in the antenna positioner for proper operation. They should be replaced when their operation becomes erratic. Refer to the positioner instruction manual for replacement information.

Table 4.1 gives operating conditions for all the relays in the system during remote and local operation. The symbol "0" signifies that the relay in that column is de-energized for the condition indicated; "1" denotes that the relay is energized. Table 4.2 describes some possible system malfunctions and corrective measures.

| | CONDITION (PREFIX A1) | POSITIONER CONTROL UNIT RELAY K1 | K2 | K3 | K4* | K5 | K6 | JUNCTION BOX RELAY A2K1 |
|---|---|---|---|---|---|---|---|---|
| REMOTE | FORWARD OUT OF LIMIT | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | FORWARD IN LIMIT | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | REVERSE OUT OF LIMIT | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| | REVERSE IN LIMIT | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| LOCAL | FORWARD OUT OF LIMIT | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| | FORWARD IN LIMIT | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| | OFF | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| | REVERSE OUT OF LIMIT | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| | REVERSE IN LIMIT | 1 | 1 | 0 | 0 | 1 | 1 | 1 |

D-421A

* USED ONLY IN PROGRAMMED OPERATION

Table 4.1. Relay Operation Chart
1=Energized; 0=De-energized

| SYMPTOM | REMOTE | LOCAL | PROGR. | CHECK |
|---|---|---|---|---|
| Power lamp does not glow when power is applied | X | X | X | Neon lamp A1DS1 |
| | X | X | X | Line fuse A1F1 |
| | X | X | X | Line connection |
| Both LIMIT INDICATOR lamps illuminated, drive motor will not run | X | | | Limit-switch circuit for continuity |
| Drive motors fail to run, regardless of selector switch position | X | X | X | Interconnecting cables |
| | X | X | X | Diodes A1CR1 through A1CR8 |
| | X | X | X | Contacts of relays A1K2, -K3, and -K5 |
| | | X | | Fuse A3F1 in local control unit |
| | X | X | X | Transformer A1T1 |
| One drive motor fails to run | X | | X | Corresponding armature fuse |
| | X | X | | Contacts of local and remote selector switches |
| Drive motor does not run in one direction; corresponding LIMIT INDICATOR not illuminated | X | X | X | Contacts of relay A1K1 |
| | X | | | Switch A1S1 |
| | | X | | Switch A3S2 in local control unit |
| | | X | | Contacts of sections A and B of switch A3S1 in local control unit |
| Drive motor does not run in one direction, corresponding LIMIT INDICATOR is illuminated | X | X | X | Connections and operation of corresponding limit switch |
| | X | X | X | Contacts of relay A1K6 |
| | X | | | Contacts of sections A, B, and D of switch A1S5 |
| Drive motor not braked to stop when limit is reached or when switch A3S4 in local control unit is released | X | X | X | Contacts of A1K3 |
| | | | X | Resistor A1R1 |
| | X | X | X | Resistor A1R2 |
| Operation is possible in only one mode with local control unit connected | X | X | | Contacts of relays A1K1 and A1K5 |
| | X | X | | Contacts of switches A1S4 and A1S5 |
| Resistor A1R1 overheats, and/or line fuse and/or fuse in local control unit blows in one position of selector switch | | X | | Contacts of relay A2K1 in junction box |
| | X | X | X | Interconnecting cables for short circuits |
| | X | X | X | Drive-motor armature current |
| Drive motor overheats and/or does not produce rated torque | X | X | X | Line voltage at A1J1 of positioner control unit (115 volts) |
| | X | X | X | Presence of field voltage at motor terminals F1 and F2 (100 ±5 volts) |
| | X | X | X | Possibility of mechanical overload |
| Limit switches will not stop motor | X | X | X | Connecting cables for short circuits |
| | X | X | X | Defective limit switch |
| | X | X | X | Connections on terminal board A1TB1 |

Table 4.2. Troubleshooting Chart

# VARIABLE AUTOTRANSFORMER MAINTENANCE

The variable autotransformer used in this unit has a stabilized brush track. If cleaning becomes necessary use only a soft cloth and a safe solvent, such as alcohol or "white" (nonleaded) gasoline. Do not use abrasives; their action may destroy the stabilized surface.

Normally, brushes will last indefinitely. Rapid brush wear is an almost certain sign of overload, although the presence of an abrasive dust can accelerate wear of both brush and brush track. Brush extension is limited to prevent contact between the metal brush shell and the winding. Operation of the brush beyond its extension limit results in arcing, indicated by a voltage drop under load. Replace brushes before this limit is reached. Refer to the parts list in this manual for the brush assembly replacement part number.

To replace the brush assembly, rotate the top plate to clear the retaining pins. Proper brush insertion is indicated by a click, or detent action, as the long axis of the top plate is aligned with the retaining pins.

Newly installed or reinstalled brushes must be correctly seated for proper operation. With power off, a few swings of the brush over the abrasive side of a piece of crocus cloth resting on the brush track will effectively mate brushes and track. Remove the crocus cloth and brush loose carbon from the brush track before applying power.

# CHAPTER 5
# REPLACEMENT PARTS LISTS

## MANUFACTURERS' CODE LETTERS

| Code | Manufacturer |
|---|---|
| ABE | Amphenol-Borg |
| AHH | Arrow, Hart & Hegeman |
| APM | Automatic & Precision Manufacturing |
| BUS | Bussman |
| CH | Cutler-Hammer |
| CRL | Centralab |
| DI | Dialight |
| GE | General Electric |
| GR | General Radio |
| HH | Harvey Hubbell |
| HMC | Hart |
| L | Littelfuse |
| MOT | Motorola |
| MS | Micro Switch |
| O | Ohmite (LD= "Little Devil") |
| PB | Potter & Brumfield |
| XX | Any brand diode or transistor which meets JEDEC standards |

PARTS LIST

MODEL 4112 POSITIONER CONTROL UNIT

The component designations are abbreviated. Previx each component with the number shown below.

A1

| Component Designation | Description | Mfr.* | Mfr. Part No. |
|---|---|---|---|
| CR1<br>CR4<br>CR7<br>CR8 | Diode, silicon | XX | 1N3211R |
| CR2<br>CR3<br>CR5<br>CR6 | Diode, silicon | XX | 1N3211 |
| CR4 | See CR1 | | |
| CR5<br>CR6 | See CR2 | | |
| CR7<br>CR8 | See CR1 | | |
| CR9<br>CR10<br>CR11 | Protector, surge | VI | SP-125 |
| DS1<br>DS2<br>DS3 | Lamp, neon-glow | GE | NE-51 |
| F1 | Fuse, 3AB, 10a, medium lag (see also paragraph 2.1.3) | L | 314010 |
| F2 | Fuse, 3AB, 10a, medium lag for 3/4 hp. | L | 314010 |
| thru | 3AG, 4a, slow blow for 1/3 hp | L | 313004 |
| F7 | 3AG, 2a, slow blow for 1/8 hp | L | 313002 |
| | 3AG, 1.5a, slow blow for 1/12 hp | L | 31301.5 |
| J1 | Connector, power input | HH | 7486 |
| J2 | Connector, receptacle, female, 17 contacts | ABE | MS3102A-20-29S |
| J3 | Connector, receptacle, female, 2 contacts | ABE | MS3102A-12S-3S |
| J4<br>J5 | Connector, receptacle, female, 22 contacts | ABE | MS3102A-28-11S |
| K1<br>K6 | Relay, 3PDT, 115v ac coil | PB | KRP14A |
| K2<br>K5 | Relay, DPDT, 115v ac coil | HMC | W115A3-008, Code 2Z |
| K3<br>K4 | Relay, DPDT, 100v dc coil | HMC | W100D3-066, Code 2Z |
| K5 | See K2 | | |
| K6 | See K1 | | |
| R1 | Resistor, fixed, wirewound, 5 ohms ±10%, 50w | O | 0400 |
| R2 | Resistor, fixed, wirewound, 5 ohms ±10%, 50w | O | 0400 |

*See "MANUFACTURERS' CODE LETTERS."

The component designations are abbreviated. Prefix each component with the number shown below.

A1

| Component Designation | Description | Mfr.* | Mfr. Part No. |
|---|---|---|---|
| S1 | Switch, toggle, DPST | CH | 7561K4 |
| S2 | Switch, micro, SPDT, with JV-20 actuator | MS | V3-601 |
| S3 | Unassigned | | |
| S4 | Switch, toggle, DPDT | CH | 7565K5 |
| S5 | Switch, rotary, 4-pole, 8-position, shorting | CRL | JV9034 |
| T1 | Transformer, variable | GR | W-5(COTAL) |
| TB1 | Terminal strip, barrier | GEN | 140-14 |
| XF1 thru XF7 | Fuse holder, panel mounting | BUS | HKP |
| XDS1 | Pilot lamp assembly, clear cap, with internal 56 k ohms, 1/3-watt resistor | DI | 521308-997 |
| XDS2 XDS3 | Pilot lamp assembly, red cap, with internal 56 k ohms, 1/3-watt resistor | DI | 521308-991 |
| XK1 XK6 | Socket, relay | ABE | 77M1P11 |
| XK2 XK3 XK4 XK5 | Socket, relay, with retaining clip | HMC | WPS-C |
| XK6 | See XK1 | | |

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

JUNCTION BOX

The component designations are abbreviated. Prefix each component with the number shown below.

A2

| Component Designation | Description | Mfr. * | Mfr. Part No. |
|---|---|---|---|
| J1 | Connector, receptacle, female, 37 contacts | ABE | MS3102A-28-21S |
| J2 | Connector, receptacle, male, 17 pins | ABE | MS3102A-20-29P |
| J3 | Connector, receptacle, male, 22 pins | ABE | MS3102A-28-11P |
| K1 | Relay, DPDT, 115v ac coil | PB | MR11A |
| P1 | Connector, cable, female, 22 contacts | ABE | MS3106A-28-11S |
| TB1 | Terminal strip, barrier | GEN | 140-16 |

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

MODEL 4112L LOCAL CONTROL UNIT

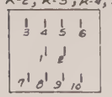
The component designations are abbreviated. Prefix each component with the number shown below.

A3

| Component Designation | Description | Mfr.* | Mfr. Part No. |
|---|---|---|---|
| F1 | Fuse, 3AB, 8a, medium lag for 3/4 hp | L | 314008 |
| | 3AG, 4a, slow blow for 1/3 hp | L | 313004 |
| | 3AG, 2a, slow blow for 1/8 hp | L | 313002 |
| | 3AG, 1.5a, slow blow for 1/12 hp | L | 31301.5 |
| P1 | Connector, cable, male, 37 pins | ABE | MS3106A-28-21P |
| S1 | Switch, rotary, 3-pole, 5-position, shorting | CRL | JV9002 |
| S2 | Switch, toggle, DPDT | CH | 7592-K6 |
| S3 | | | |
| S4 | Switch, pushbutton, SPST, N.O. | AHH | 81075-Q |
| -- | Front-Panel Weatherproof Screws | AMP | 8-32 x 3/8" "Seelskrews" |
| -- | Rotary Switch Seal | APM | N-9030-1/4 |
| -- | Toggle Switch Seal | APM | N1030B |
| -- | Pushbutton Seal | APM | NC-3030 |

*See "MANUFACTURERS' CODE LETTERS."

RELAY BASING
K-2, K-3, K-4, K-5




NOTES:
1. TERMINALS NO 7 & 8 ON TB-1 ARE THE LIMIT SWITCH RETURNS, IF LIMIT SWITCHES ARE NOT USED ON A PARTICULAR POSITIONER AXIS THE FOLLOWING JUMPERS MUST BE MADE ON TB-1
   AZ-1 7 OR 8 TO 1 & 9
   EL-1 7 OR 8 TO 2 & 10
   AUX-1 7 OR 8 TO 3 & 11
   AZ-2 7 OR 8 TO 4 & 12
   EL-2 7 OR 8 TO 5 & 13
   AUX-2 7 OR 8 TO 6 & 14
2. RING R8S ON U-2 MUST BE SHORTED TOGETHER IF PCP OR LOCAL CONTROL IS NOT USED.

| FUSE DATA | | | | |
|---|---|---|---|---|
| MOTOR SIZE | F1 | F2,3,4,5,6,7 | | TYPE |
| 3/4 HP | 10A | 8A | 3AB | MEDIUM LAG |
| 1/3 HP | 5A | 4A | 3AS | SLOW-BLOW |
| 1/6 HP | 3A | 2A | 3AG | SLOW-BLOW |
| 1/2 HP | 3A | 1.5A | 3AG | SLOW-BLOW |

F-1 SHOULD BE CHOSEN FOR LARGEST MOTOR BEING USED.

L1 - AC HOT
L2 - AC COMMON

J-1
POWER INPUT
115V RMS

MS-3106A-12S-3P
MS-3102A-12S-3S
J-3
TO INDICATOR UNIT

J-4
TO POSITIONER NO. 1
MS-3106A-28-11P
MS-3102A-28-11S

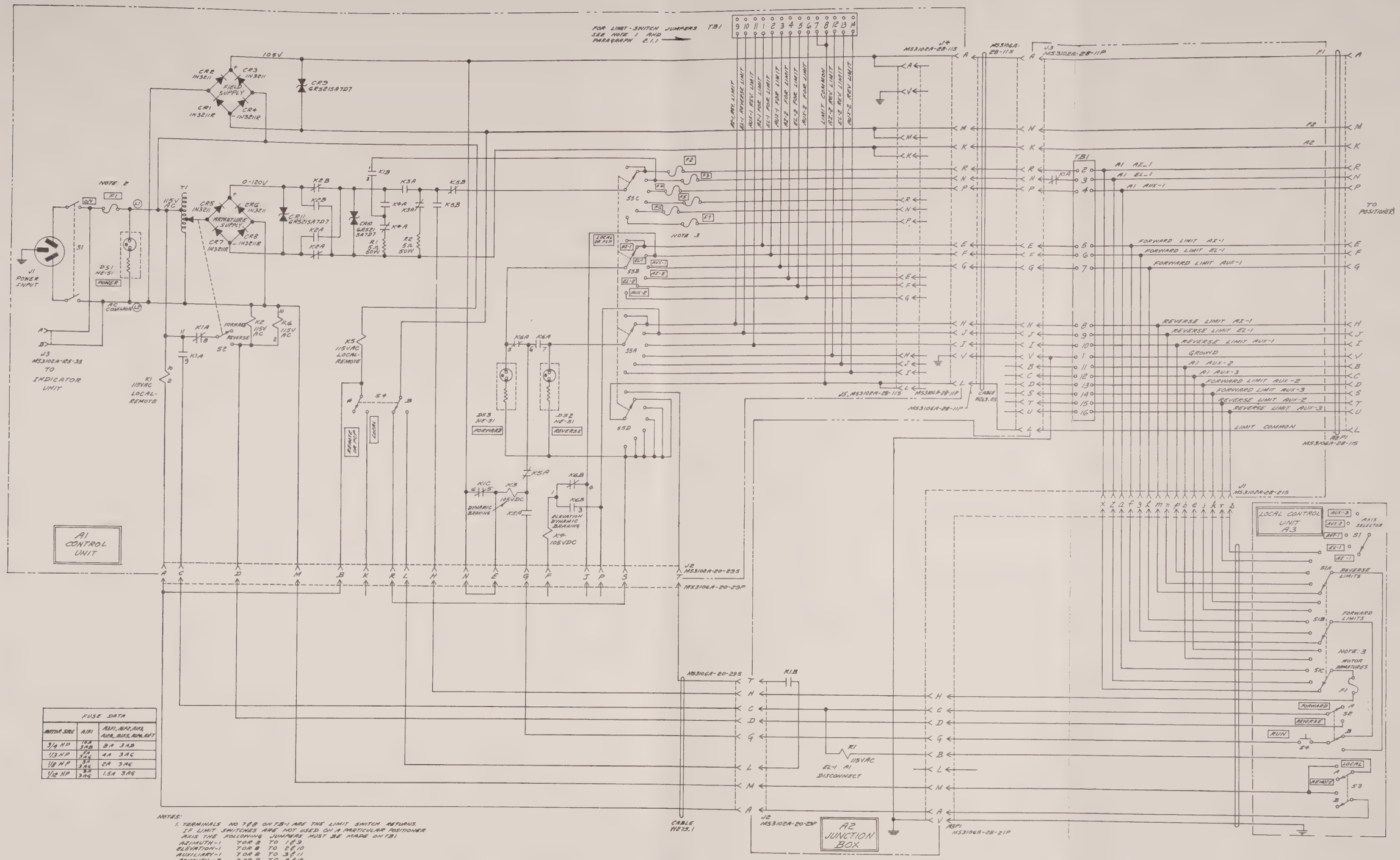
J-5
TO POSITIONER NO. 2
MS-3106A-18-11P
MS-3102A-28-11S

J-2
MS-3102A-20-29S
MS-3106A-20-29P

TO PROGRAMMER OR LOCAL JUNCTION BOX

NOTE 1
NOTE 2

Model 4112 Positioner Control Unit
Schematic Diagram




| FUSE DATA | | |
|---|---|---|
| MOTOR SIZE | A1F1 | A2F1, A1F2, A1F3, A1F8, A1F5, A1F6, A1F7 |
| 3/4 HP | 10A 3AB | 8A 3AB |
| 1/3 HP | 5A 3AG | 4A 3AG |
| 1/8 HP | 3A 3AG | 2A 3AG |
| 1/12 HP | 3AG 3A | 1.5A 3AG |

NOTES:
1. TERMINALS NO. 7 & 8 ON TB1 ARE THE LIMIT SWITCH RETURNS. IF LIMIT SWITCHES ARE NOT USED ON A PARTICULAR POSITIONER AXIS THE FOLLOWING JUMPERS MUST BE MADE ON TB1
   AZIMUTH-1 7 OR 8 TO 1 & 9
   ELEVATION-1 7 OR 8 TO 2 & 10
   AUXILIARY-1 7 OR 8 TO 3 & 11
   AZIMUTH-2 7 OR 8 TO 4 & 12
   ELEVATION-2 7 OR 8 TO 5 & 13
   AUXILIARY-2 7 OR 8 TO 6 & 14
2. FOR FUSE SIZE, SEE PARAGRAPH 2.1.2
3. FOR FUSE SIZE, SEE PARAGRAPH 2.1.3

PARTIAL REFERENCE DESIGNATIONS ARE SHOWN AHEAD WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.

Model 4112 Positioner Control Unit with Model 4112L Local Control Unit Schematic Diagram

# CONVERSION OF VOLTAGE AND POWER RATIOS TO DECIBELS

The basic chart below indicates the number of decibels (db) corresponding to the listed ratios of voltage or power over the range of −20 to +20 db. For voltage or power ratios greater than those included in the chart, the ratio can be broken down into a product of two numbers, the value in db for each found separately, and the two results added. Example: To convert a power ratio of 2,000:1 to db, express 2,000 as $2 \times 10^3$; the number of db corresponding to a power ratio of 2 is very nearly 3, and the number of db for a power ratio of $10^3$ is 30. Therefore, the power ratio of 2,000:1 is approximately 30 db + 3 db = 33 db. In the lower right-hand corner of the chart db values for voltage and power ratios of integral powers of 10 are given.

| Voltage Ratio | Power Ratio | —db+ | Voltage Ratio | Power Ratio | Voltage Ratio | Power Ratio | —db+ | Voltage Ratio | Power Ratio | Voltage Ratio | Power Ratio | —db+ | Voltage Ratio | Power Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 1.000 | 0 | 1.000 | 1.000 | .447 | .200 | 7.0 | 2.239 | 5.012 | .200 | .0398 | 14.0 | 5.012 | 25.12 |
| .989 | .977 | .1 | 1.012 | 1.023 | .442 | .195 | 7.1 | 2.265 | 5.129 | .197 | .0389 | 14.1 | 5.070 | 25.70 |
| .977 | .955 | .2 | 1.023 | 1.047 | .437 | .191 | 7.2 | 2.291 | 5.248 | .195 | .0380 | 14.2 | 5.129 | 26.30 |
| .966 | .933 | .3 | 1.035 | 1.072 | .432 | .186 | 7.3 | 2.317 | 5.370 | .193 | .0372 | 14.3 | 5.188 | 26.92 |
| .955 | .912 | .4 | 1.047 | 1.096 | .427 | .182 | 7.4 | 2.344 | 5.495 | .191 | .0363 | 14.4 | 5.248 | 27.54 |
| .944 | .891 | .5 | 1.059 | 1.122 | .422 | .178 | 7.5 | 2.371 | 5.623 | .188 | .0355 | 14.5 | 5.309 | 28.18 |
| .933 | .871 | .6 | 1.072 | 1.148 | .417 | .174 | 7.6 | 2.399 | 5.754 | .186 | .0347 | 14.6 | 5.370 | 28.84 |
| .923 | .851 | .7 | 1.084 | 1.175 | .412 | .170 | 7.7 | 2.427 | 5.888 | .184 | .0339 | 14.7 | 5.433 | 29.51 |
| .912 | .832 | .8 | 1.096 | 1.202 | .407 | .166 | 7.8 | 2.455 | 6.026 | .182 | .0331 | 14.8 | 5.495 | 30.20 |
| .902 | .813 | .9 | 1.109 | 1.230 | .403 | .162 | 7.9 | 2.483 | 6.166 | .180 | .0324 | 14.9 | 5.559 | 30.90 |
| .891 | .794 | 1.0 | 1.122 | 1.259 | .398 | .159 | 8.0 | 2.512 | 6.310 | .178 | .0316 | 15.0 | 5.623 | 31.62 |
| .881 | .776 | 1.1 | 1.135 | 1.288 | .394 | .155 | 8.1 | 2.541 | 6.457 | .176 | .0309 | 15.1 | 5.689 | 32.36 |
| .871 | .759 | 1.2 | 1.148 | 1.318 | .389 | .151 | 8.2 | 2.570 | 6.607 | .174 | .0302 | 15.2 | 5.754 | 33.11 |
| .861 | .741 | 1.3 | 1.161 | 1.349 | .385 | .148 | 8.3 | 2.600 | 6.761 | .172 | .0295 | 15.3 | 5.821 | 33.88 |
| .851 | .724 | 1.4 | 1.175 | 1.380 | .380 | .145 | 8.4 | 2.630 | 6.918 | .170 | .0288 | 15.4 | 5.888 | 34.67 |
| .841 | .708 | 1.5 | 1.189 | 1.413 | .376 | .141 | 8.5 | 2.661 | 7.079 | .168 | .0282 | 15.5 | 5.957 | 35.48 |
| .832 | .692 | 1.6 | 1.202 | 1.445 | .372 | .138 | 8.6 | 2.692 | 7.244 | .166 | .0275 | 15.6 | 6.026 | 36.31 |
| .822 | .676 | 1.7 | 1.216 | 1.479 | .367 | .135 | 8.7 | 2.723 | 7.413 | .164 | .0269 | 15.7 | 6.095 | 37.15 |
| .813 | .661 | 1.8 | 1.230 | 1.514 | .363 | .132 | 8.8 | 2.754 | 7.586 | .162 | .0263 | 15.8 | 6.166 | 38.02 |
| .804 | .646 | 1.9 | 1.245 | 1.549 | .359 | .129 | 8.9 | 2.786 | 7.762 | .160 | .0257 | 15.9 | 6.237 | 38.90 |
| .794 | .631 | 2.0 | 1.259 | 1.585 | .355 | .126 | 9.0 | 2.818 | 7.943 | .159 | .0251 | 16.0 | 6.310 | 39.81 |
| .785 | .617 | 2.1 | 1.274 | 1.622 | .351 | .123 | 9.1 | 2.851 | 8.128 | .157 | .0246 | 16.1 | 6.383 | 40.74 |
| .776 | .603 | 2.2 | 1.288 | 1.660 | .347 | .120 | 9.2 | 2.884 | 8.318 | .155 | .0240 | 16.2 | 6.457 | 41.69 |
| .767 | .589 | 2.3 | 1.303 | 1.698 | .343 | .118 | 9.3 | 2.917 | 8.511 | .153 | .0234 | 16.3 | 6.531 | 42.66 |
| .759 | .575 | 2.4 | 1.318 | 1.738 | .339 | .115 | 9.4 | 2.951 | 8.710 | .151 | .0229 | 16.4 | 6.607 | 43.65 |
| .750 | .562 | 2.5 | 1.334 | 1.778 | .335 | .112 | 9.5 | 2.985 | 8.913 | .150 | .0224 | 16.5 | 6.683 | 44.67 |
| .741 | .550 | 2.6 | 1.349 | 1.820 | .331 | .110 | 9.6 | 3.020 | 9.120 | .148 | .0219 | 16.6 | 6.761 | 45.71 |
| .733 | .537 | 2.7 | 1.365 | 1.862 | .327 | .107 | 9.7 | 3.055 | 9.333 | .146 | .0214 | 16.7 | 6.839 | 46.77 |
| .724 | .525 | 2.8 | 1.380 | 1.905 | .324 | .105 | 9.8 | 3.090 | 9.550 | .145 | .0209 | 16.8 | 6.918 | 47.86 |
| .716 | .513 | 2.9 | 1.396 | 1.950 | .320 | .102 | 9.9 | 3.126 | 9.772 | .143 | .0204 | 16.9 | 6.998 | 48.98 |
| .708 | .501 | 3.0 | 1.413 | 1.995 | .316 | .100 | 10.0 | 3.162 | 10.000 | .141 | .0200 | 17.0 | 7.079 | 50.12 |
| .700 | .490 | 3.1 | 1.429 | 2.042 | .313 | .0977 | 10.1 | 3.199 | 10.23 | .140 | .0195 | 17.1 | 7.161 | 51.29 |
| .692 | .479 | 3.2 | 1.445 | 2.089 | .309 | .0955 | 10.2 | 3.236 | 10.47 | .138 | .0191 | 17.2 | 7.244 | 52.48 |
| .684 | .468 | 3.3 | 1.462 | 2.138 | .306 | .0933 | 10.3 | 3.273 | 10.72 | .137 | .0186 | 17.3 | 7.328 | 53.70 |
| .676 | .457 | 3.4 | 1.479 | 2.188 | .302 | .0912 | 10.4 | 3.311 | 10.96 | .135 | .0182 | 17.4 | 7.413 | 54.95 |
| .668 | .447 | 3.5 | 1.496 | 2.239 | .299 | .0891 | 10.5 | 3.350 | 11.22 | .133 | .0178 | 17.5 | 7.499 | 56.23 |
| .661 | .437 | 3.6 | 1.514 | 2.291 | .295 | .0871 | 10.6 | 3.388 | 11.48 | .132 | .0174 | 17.6 | 7.586 | 57.54 |
| .653 | .427 | 3.7 | 1.531 | 2.344 | .292 | .0851 | 10.7 | 3.428 | 11.75 | .130 | .0170 | 17.7 | 7.674 | 58.88 |
| .646 | .417 | 3.8 | 1.549 | 2.399 | .288 | .0832 | 10.8 | 3.467 | 12.02 | .129 | .0166 | 17.8 | 7.762 | 60.26 |
| .638 | .407 | 3.9 | 1.567 | 2.455 | .285 | .0813 | 10.9 | 3.508 | 12.30 | .127 | .0162 | 17.9 | 7.852 | 61.66 |
| .631 | .398 | 4.0 | 1.585 | 2.512 | .282 | .0794 | 11.0 | 3.548 | 12.59 | .126 | .0159 | 18.0 | 7.943 | 63.10 |
| .624 | .389 | 4.1 | 1.603 | 2.570 | .279 | .0776 | 11.1 | 3.589 | 12.88 | .125 | .0155 | 18.1 | 8.035 | 64.57 |
| .617 | .380 | 4.2 | 1.622 | 2.630 | .275 | .0759 | 11.2 | 3.631 | 13.18 | .123 | .0151 | 18.2 | 8.128 | 66.07 |
| .610 | .372 | 4.3 | 1.641 | 2.692 | .272 | .0741 | 11.3 | 3.673 | 13.49 | .122 | .0148 | 18.3 | 8.222 | 67.61 |
| .603 | .363 | 4.4 | 1.660 | 2.754 | .269 | .0724 | 11.4 | 3.715 | 13.80 | .120 | .0145 | 18.4 | 8.318 | 69.18 |
| .596 | .355 | 4.5 | 1.679 | 2.818 | .266 | .0708 | 11.5 | 3.758 | 14.13 | .119 | .0141 | 18.5 | 8.414 | 70.79 |
| .589 | .347 | 4.6 | 1.698 | 2.884 | .263 | .0692 | 11.6 | 3.802 | 14.45 | .118 | .0138 | 18.6 | 8.511 | 72.44 |
| .582 | .339 | 4.7 | 1.718 | 2.951 | .260 | .0676 | 11.7 | 3.846 | 14.79 | .116 | .0135 | 18.7 | 8.610 | 74.13 |
| .575 | .331 | 4.8 | 1.738 | 3.020 | .257 | .0661 | 11.8 | 3.890 | 15.14 | .115 | .0132 | 18.8 | 8.710 | 75.86 |
| .569 | .324 | 4.9 | 1.758 | 3.090 | .254 | .0646 | 11.9 | 3.936 | 15.49 | .114 | .0129 | 18.9 | 8.811 | 77.62 |
| .562 | .316 | 5.0 | 1.778 | 3.162 | .251 | .0631 | 12.0 | 3.981 | 15.85 | .112 | .0126 | 19.0 | 8.913 | 79.43 |
| .556 | .309 | 5.1 | 1.799 | 3.236 | .248 | .0617 | 12.1 | 4.027 | 16.22 | .111 | .0123 | 19.1 | 9.016 | 81.28 |
| .550 | .302 | 5.2 | 1.820 | 3.311 | .246 | .0603 | 12.2 | 4.074 | 16.60 | .110 | .0120 | 19.2 | 9.120 | 83.18 |
| .543 | .295 | 5.3 | 1.841 | 3.388 | .243 | .0589 | 12.3 | 4.121 | 16.98 | .108 | .0118 | 19.3 | 9.226 | 85.11 |
| .537 | .288 | 5.4 | 1.862 | 3.467 | .240 | .0575 | 12.4 | 4.169 | 17.38 | .107 | .0115 | 19.4 | 9.333 | 87.10 |
| .531 | .282 | 5.5 | 1.884 | 3.548 | .237 | .0562 | 12.5 | 4.217 | 17.78 | .106 | .0112 | 19.5 | 9.441 | 89.13 |
| .525 | .275 | 5.6 | 1.905 | 3.631 | .234 | .0550 | 12.6 | 4.266 | 18.20 | .105 | .0110 | 19.6 | 9.550 | 91.20 |
| .519 | .269 | 5.7 | 1.928 | 3.715 | .232 | .0537 | 12.7 | 4.315 | 18.62 | .104 | .0107 | 19.7 | 9.661 | 93.33 |
| .513 | .263 | 5.8 | 1.950 | 3.802 | .229 | .0525 | 12.8 | 4.365 | 19.05 | .102 | .0105 | 19.8 | 9.772 | 95.50 |
| .507 | .257 | 5.9 | 1.972 | 3.890 | .227 | .0513 | 12.9 | 4.416 | 19.50 | .101 | .0102 | 19.9 | 9.886 | 97.72 |
| .501 | .251 | 6.0 | 1.995 | 3.981 | .224 | .0501 | 13.0 | 4.467 | 19.95 | .100 | .0100 | 20.0 | 10.000 | 100.00 |
| .496 | .246 | 6.1 | 2.018 | 4.074 | .221 | .0490 | 13.1 | 4.519 | 20.42 | | | | | |
| .490 | .240 | 6.2 | 2.042 | 4.169 | .219 | .0479 | 13.2 | 4.571 | 20.89 | | $10^{-3}$ | 30 | | $10^3$ |
| .484 | .234 | 6.3 | 2.065 | 4.266 | .216 | .0468 | 13.3 | 4.624 | 21.38 | $10^{-2}$ | $10^{-4}$ | 40 | $10^2$ | $10^4$ |
| .479 | .229 | 6.4 | 2.089 | 4.365 | .214 | .0457 | 13.4 | 4.677 | 21.88 | | | | | |
| .473 | .224 | 6.5 | 2.113 | 4.467 | .211 | .0447 | 13.5 | 4.732 | 22.39 | | $10^{-5}$ | 50 | | $10^5$ |
| .468 | .219 | 6.6 | 2.138 | 4.571 | .209 | .0437 | 13.6 | 4.786 | 22.91 | $10^{-3}$ | $10^{-6}$ | 60 | $10^3$ | $10^6$ |
| .462 | .214 | 6.7 | 2.163 | 4.677 | .207 | .0427 | 13.7 | 4.842 | 23.44 | | $10^{-7}$ | 70 | | $10^7$ |
| .457 | .209 | 6.8 | 2.188 | 4.786 | .204 | .0417 | 13.8 | 4.898 | 23.99 | $10^{-4}$ | $10^{-8}$ | 80 | $10^4$ | $10^8$ |
| .452 | .204 | 6.9 | 2.213 | 4.898 | .202 | .0407 | 13.9 | 4.955 | 24.55 | | $10^{-9}$ | 90 | | $10^9$ |
| | | | | | | | | | | $10^{-5}$ | $10^{-10}$ | 100 | $10^5$ | $10^{10}$ |
| | | | | | | | | | | | $10^{-11}$ | 110 | | $10^{11}$ |
| | | | | | | | | | | $10^{-6}$ | $10^{-12}$ | 120 | $10^6$ | $10^{12}$ |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